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Examining the Influence of UK Public Clients' Characteristics on Their Own Innovation-Decision towards the Modern Methods of Construction (MMC)

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Abstract: Construction has long been identified as an industry resistant to change and innovation, a reality that has prevailed to shape its overall reputation. The public sector includes an influential client type that dominates the major percentage of construction demand and is subject to public law. The Modern Methods of Construction (MMC) have been championed recently by the UK government and early adopters upon the emergence of data indicating their effectiveness in addressing key construction challenges. However, the uptake of MMC has been low among UK construction clients, particularly among public client organisations. Theories emerge across decades to inform researchers of variable clusters that can aid a broader understanding of decision-making and innovation adoption. One of the popular innovation theories suggests a relation between the characteristics of decision-makers and their own innovation decisions. This paper, therefore, aims to investigate the characteristics that are responsible for public clients' low MMC uptake despite the associated relative advantages. Overall, 91 public client organisations have responded to this research's survey, reflecting their organisation's characteristics in line with the constructs adapted from the Diffusion of Innovation (DOI) theory. Results suggest that among the ten influences that are captured from a detailed review of the literature, confidence in MMC firms supersedes all other factors in critically influencing the organisation's favourable decision towards using MMC. Evidence provided in this paper suggests that a communication issue is presenting itself in the public construction sector, which is evident by the lack of confidence that public clients have in MMC businesses. This is the first study to utilise quantitative means to examine construction clients' characteristics and relate the same to the adoption of construction innovation. Future research is encouraged to acknowledge the most influencing characteristics and detail how such knowledge can be embraced by supply to develop business models that can orchestrate better confidence in the public sector.

Keywords: modern methods of construction; public clients; diffusion of innovation



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1. Introduction

Construction innovations emerge as a natural reflex to tackle a spectrum of challenges lurking and pulling the construction industry away from thriving compared to other major sectors. These innovations have been argued to be driven by the need for change [1], the benefits of change [2], and the mandated necessity to change [3]. Innovations, albeit diverse and broad in their general sense and application, are habitually rejected, and slowly adopted [4]. Accelerating the adoption of construction innovations remains a hot topic bedeviling construction research for decades [5]. Previous efforts shed light on the complexity of the diffusion of construction innovations across the construction industry. For instance, Xu et al. [6] relate this to the diffusion of BIM, Mead et al. [7] to the acceleration of sustainable methods, and Besklubova et al. [8] to the promotion of the use of 3D printing. Despite that such studies exploring the adoption of innovations in construction are radically

different, what commonly transpires is the non-simplistic posture when investigating the adoption-decision of organisations in the construction context.

Among the emerging innovations that intend to address contemporary construction challenges are ones that demand a more fundamental transformation. The Modern Methods of Construction (MMC) are methods that dictate a shift from the disjointed ways of delivering construction projects to a more controlled environment [9]. The history of MMC, in the United Kingdom, is traced back to the post-war era, when the market needed a quick housing and construction solution to meet the suddenly required volumes [10]. The immaturity of the construction market at the time meant that such methods would plummet in demand, associating MMC with a reputation that hindered their wider uptake compared to traditionally accepted ways of construction [11]. Tentatively, some of the dominating perceptions that have been argued are fire resistance [12], quality issues [13], and the inflexibility of designs [14]. Such undesirable associations, among a handful of others, halted MMC from being mainstreamed.

However, the interest in MMC has resurfaced recently after influential industries have demanded radical change due to the sensed “inexorable decline” of the sector nurtured by the conventionally adopted ways, as described by Farmer [15] (p. 5). Ehwi et al. [16], who conducted a systematic review of the past relevant literature, report an unusual peak of MMC-related publications in the past five years, reflecting increasing academic attention and interest in construction research. Having a similar interest to industry and academia, the UK government has recently published the Construction Playbook, a key document that comprises vital policies with a special focus on facilitating the adoption of innovation across the UK public sector, acknowledging that “we need to actively consider how we can maximise the use of MMC” [17] (p. 20). The interest could be explained by the realisation, through evidence, of the benefits and values of MMC. For instance, MMC is excelling in addressing critical construction concerns such as safety [18,19], waste [20], cost [21,22], and the favouring of business with smaller firms [23,24]. A reasonable question, thus, is whether the re-emergence of such interest from practice, academia, and regulatory bodies may offer an invaluable opportunity for MMC to finally prevail over traditional construction methods.

The arguments relating to facilitating innovations and prevailing innovations stand to be complex and wider topics in essence. To systematically approach this, building a rationale that challenges the ongoing direction of the recent literature and governmental publications is necessary. A review of the literature, from the past decade, informs academia’s direction in being mostly bounded by the characteristics of MMC itself, rather than the characteristics of the adopters [12,14,25–34]. Such a research direction drives the authors to question the existence of a potential research gap, driven by the indecision of researchers to focus on demand rather than exclusively on innovation. Appelbaum’s [35] (p. 1) afterword, which uses the phrase, “Reinventing ourselves to change the world”, motivates the authors to rethink the popular attention amidst the flow of contributions in one limited direction. The authors find that the focus on MMC exclusively, with the discreetness of academic efforts to study adopters, may delimit the broader understanding of the pressure points critical for a fundamental change. The merit here, hence, would be in examining a social system that can be argued to sustain an influential status worthy of an empirical investigation to understand how to drive better flow and demand of MMC across the construction sector.

An extremely understudied yet influential social system in construction research is the public sector. The little attention spent by construction academic research on public clients is surprising, particularly since the magnitude of the private sector is nearly four times smaller than the public sector, where the former has a growth proportion of £750 million compared to the latter’s proportion of £2.7 bn [36]. Such numbers classify the public sector as a “purchasing power” [37] (p. 128), placing it in a position of influence to facilitate the adoption of innovation [38]. Differences in magnitude between public and private sectors also mean differences in values and needs, as the private sector tends to emphasise its

own interests while the public sector is driven by enhancing public welfare [30]. Such differences in what drives clients' value for investment mean fundamental changes in the dynamics where organisations perceive innovations as valuable [39]. Reasonably, the public sector has less drive and uptake towards construction innovations [40]. However, this does not change the assumption that public clients' influence is critical and would mean driving the overall industry through their significant demand [41]. In the MMC context, public clients' adoption of MMC remains understudied, with a considerably low uptake of these innovations [42]. The question here, hence, is refined to argue the reasons behind the public sector's low adoption of MMC despite the considerable alignment with their values and needs.

Due to limited research that endeavours to fully understand the influential and important status of public clients, this paper, therefore, seeks to not only pinpoint this gap in the literature but also to utilise empirical means to investigate, for the first time, the adoption of MMC in the UK public sector. To approach this, it is essential to build upon robust theoretical grounds, especially when the use of theories has been indicated as very limited in past MMC research [16]. One of the widely accepted theories is the diffusion of innovation theory by Rogers [4], which conceptualises the formation and flow of decision-making across innovation adopters. At an organizational level, the theory offers constructs that help classify characteristics of adopters in isolation of the innovation's attributes, or how it is technically perceived, where such characteristics have been argued to either promote or inhibit a favourable innovation decision. The following sections, hereby, will respond to and build upon the calls of recent studies on the need for comparable research to better investigate the low MMC adoption within the sector [30,38,43–45].

The study's sections are organised to tell the story of the academic journey adopted in this paper. It initially presents a detailed literature review that adopts an MMC definition and discusses the importance of public clients, followed by the paper's theoretical standing. Thereafter, the established methodological choice of quantitative methods of research is substantiated to assess public clients' characteristics, this explains how data is collected and analysed. Finally, the novel and empirical findings of this study are presented and discussed to pinpoint the key concluding remarks.

The aim of this paper, hence, is to identify and examine the relationship between the characteristics of the decision-makers in UK public client organisations and their innovation-decision towards MMC. This paper is considered the first to relate the categorisation of characteristics to innovation in the public construction context, advancing Rogers's theory and the work of colleagues of similar efforts to drive MMC adoption; these are considered invaluable and timely amidst the greater interest in MMC by both research and practice. This paper approaches its aim by exploring the following questions:

- RQ1. What are the characteristics of public clients in the construction context?
- RQ2. Are the captured characteristics influencing their MMC uptake?

2. Literature Review

2.1. *Modern Methods of Construction: The Innovation*

The use of the term MMC has been associated with myriad benefits despite the lack of a clear terminological definition [46]. It is necessary, therefore, to define what is exactly meant by MMC when investigating its adoption within this paper's context. Nawi et al. [47] demonstrate a need to harmonise a standard MMC terminology that would clarify its application. A lack of a standard definition is promoting the use of MMC in meanings that may not align with their real connotation [31]. Moreover, existing terminologies are not coherent with what MMC accurately is, being utilised interchangeably with multiple meanings [46]. The literature, thus, reflects that MMC is defined based on context, rather than a terminological standardisation.

Taylor [36], who addresses these confusions, reflected a debate in the academic body on a standard MMC definition, as terms are being rebranded to approach specific rationales. In the broader sense, it is apparent that there is a lack of one exclusive, agreed upon, defini-

tion that best describes MMC. Technically, Ginigaddara et al. [48] indicate the relevancy of the term to detail the use of volumetric structures, nonvolumetric components, and other modules and pods. This aligns with the definition by the UK Ministry of Housing, Communities & Local Government, in their report published in 2019, classifying MMC into seven different categories [49]. Hence, it is vital for the adopted definition in this paper to fit into both the research's context and the meaning that would be then relevantly communicated in the data collection.

This study acknowledges the differences between the detailed definitions and appreciates that a common and unified coherence exists throughout these differences that describe MMC as a transformation of traditional construction methods from their uncontrolled onsite nature to those that capture critical efficiency and sustainability values by shifting to a controlled offsite built environment. The definition adopted in this paper, hence, is closest to that provided in the revised version of the Construction Playbook, published by the UK government, stating that "Modern Methods of Construction (MMC) is a wide term, covering a range of offsite and onsite techniques. MMC provides alternatives to traditional methods and has the potential to deliver significant improvements in productivity, efficiency and quality for both the construction industry and public sector" [17] (p. 20). The authors' adoption of this definition is reasonable within the context of this paper's exclusive interest in the UK public sector.

2.2. Public Construction Clients: The Social System

Public clients are organisations that adhere to public law and deliver services to the benefit of the public [41]. This process involves interaction with individuals, public and private organisations, and the government [50]. Such client organisations have been described by the literature as "in the right position" to influence and demand change [51]. Innovation-wise, public clients have been described as the drivers for industry change [52], and, in some studies, referred to as change agents [53,54]. Linking such a change influence and potential to the construction context, Bonham [53] reports that if public clients adopt a construction innovation, this may trigger the whole industry to follow in their footsteps. Public construction clients have varied interests, such as healthcare [55], housing [56], and infrastructure [57], all of which are part of their purpose of seeking public welfare and social value [58]. Hence, understanding the indecision of these organisations to adopt MMC in their projects is critical.

In general, clients are underexplored when investigating the adoption of construction innovations [59], compared to the popular direction of research to prefer contractors over clients [60]. There is a lack of understanding of how construction innovations flow among public clients [61]. To lead by example, Bonham [53] reports that successful public clients would need to attain special characteristics that can distinguish their position towards innovations. These characteristics, however, are not simply achieved and are often shaped by political pressures and policies [62,63]. Rosander [54] emphasises the need to study public clients and unravel their characteristics that would better aid a wider understanding of the dynamics and predictabilities of these organisations. Hence, a review of the literature indicates the complexity of the decision-making process in public client organisations. Tentatively, they attain traits that discourage innovation initiatives [64] and contradict what is perceived as value [41].

The process of change is traced to the issues of identity, broken down into values, tasks, roles, and competencies so that what is perceived as new could then align with what is perceived as normal [65]. Relating this to how an innovation is rolled out in public bodies, Carpenter [66] discusses that the matter of urgency, or social unrest, is crucial to pressuring regulatory agencies to mandate policies that foster innovations. Despite that mandating policies have been encouraged to drive more adoption of construction innovations [67], it is necessary to consider the characteristics of public clients that can frame an effective discretionary mandating of relative policies, which can then yield maximum benefits when promoting construction innovations [68]. However, Lindblad and Karrbom

Gustavsson [69] report that there is a tendency to neglect the role of clients in fostering change in construction research, which results in fewer contributions to this area.

The literature, overall, comprises minimal studies focused on presenting an empirical setting that would reflect how favourable decisions are made toward construction innovations, such as MMC, and how these decisions are influenced by organisational characteristics. For more than a decade, studies have focused on client satisfaction [70,71] rather than on client characteristics [60]. However, such characteristics indirectly emerge to inform researchers of their tentative potential to steer organisations' decisions. For instance, in the UK, the National Audit Office called for the need for skill development in public client organisations [72], where a misalignment of change with the job positions would mean that resistance will often arise [61]. Moreover, Walshe et al. [73] show that the characteristics and structure of public client organisations could determine their organisational improvements. Such characteristics have driven Manley [74] (p. 1297) to describe clients as "innovation-incompetent". Hedgren and Stehn [59] offer an interesting perspective that details how public client organisations can fundamentally differ and how in these differences lurks the merit, acting as a frame of reference for their MMC decision-making. A review of these studies motivates the authors to question, conceptually, what are the characteristics that are rooted in public client organisations and are, perhaps unconsciously, orchestrating their decision-making towards construction innovations like MMC.

2.3. Characteristics of Decision-Makers: Diffusion of Innovation Theory (DOI)

Ensuring this paper's robust theoretical standing is essential to reinforce broader knowledge of public clients and explain their decision-making. The Diffusion of Innovation theory (DOI), by Rogers [4], conceptualises a critical set of influences that steers the decision-making process towards, or away from, innovations. One segment of these influences is the characteristics of decision-makers themselves. The theory, meant to pinpoint how innovations flow across social systems, classifies these constructs into socioeconomic characteristics, personality variables, and communication behaviours. The application of this theory has been seen in a range of innovation studies, such as renewable energy [75], sustainability management [76], and alternative fuel vehicles [77]. To the authors' knowledge, however, this paper is the first to apply these constructs from the DOI theory, particularly in the construction empirical setting.

A valid question is the significance and extent of contribution that is associated with detailing the characteristics of public client organisations towards an innovation. The overall knowledge of public clients is limited, this has been pinpointed by the literature, where the implications of this lack of knowledge mean that the government, contractors, and integrators are unaware of the differences to which their strategies are effective, or ineffective, as the ability to target organisations is dictated by the demonstrated and informed knowledge of the differences in clients' categorisation [78–80]. The literature, however, provides enough evidence to suggest the viability and needs of this paper's direction. For instance, Eriksson et al. [64] argue that the level of MMC adoption is linked to the level of the conservative attitude attained by clients towards this innovation. Moreover, despite MMC's realisable potential to meet public clients' needs and values [78], this has been discussed as not enough of a reason for organisations to adopt an innovation [4]. It is reasonable to state that public client organisations are complex social systems [51]. Oti-Sarpong et al. [79] briefly touch on this argument, detailing a relation between the adaptive behaviour of actors to their characteristics. However, the vast literature remains discreet, motivating the authors to understand such characteristics and offer academic contributions to fill this gap.

2.4. Conceptualisation and Hypotheses

2.4.1. Socio-Economic Characteristics

The first decision-maker construct, detailed by Rogers [4], comprises the socio-economical characteristics. This has been developed to reflect the social and economic status of decision-

makers and their organisations, where the DOI theory argues a critical relationship between the characteristics under this cluster and a favourable innovation decision. This subsection examines past articles and includes four hypotheses derived from an in-depth analysis of the literature. Variables are listed as knowledge and experience, and the credit attitude of the decision-makers in public client organisations.

The successful outcomes of construction projects have been directly linked to clients' education [43]. In the public sector, Vass and Gustavsson [61] indicate the need for education among public client staff to facilitate the adoption of innovation. Moreover, willingness to adopt innovations, solely, with a lack of adequate education has been indicated as insufficient [42]. There seems to be a reflection by the academic literature on the level where education influences innovation-decision. Reasonably, organisations comprising decision-makers that have attained high levels of education are associated with a higher level of innovation adoption [4]. O'Connor et al. [80] underline the need for educational modules to help clients realise the benefits of MMC, similarly emphasising the relationship between education and innovation. The detailed review of the literature, moreover, informs the authors of another potential key characteristic that may influence a favourable decision towards MMC. In theory, attaining experience in the innovation to be adopted positively influences the decision towards adoption [4]. Rahman [81] associates the level of experience in MMC with the level of fear when considering adoption. Empirically, Salama et al. [82] conducted a case study that investigated clients with prior MMC experience, a characteristic that enabled clear communication of needs and facilitated the adoption decision. Similarly, lack of experience is associated with unrealistic expectations of the potential of MMC, which facilitated a non-favourable innovation decision [42]. This has been explained by the preference for familiarity when adopting construction methods [83]. Adam and Lindahl [60] propose strengthening the hiring process in public client organisations so that employed candidates would attain more experience. More knowledge and experience, hence, would aid better judgement, in turn, aiding better prospects for innovation adoption [84]. Such considerations, therefore, support the proposal of the following hypothesis.

H1. *A higher level of knowledge and experience is positively related to MMC uptake.*

Another socioeconomic characteristic that emerges from the detailed review of the literature is the relationship between credit levels and innovation adoption. Rogers [4] explains the relationship between decision-makers who have a greater appetite to borrow money and their level of innovation adoption. This relationship, however, remains discreet in the literature, particularly in the contexts of construction and the public sector [85]. It is logical to state that assessing this relationship in the public sector may yield results that differ from the private sector due to the associated accountability of clients accessing public funds [86]. This potentially restricted access may mean that public clients' decisions would be highly linked to their ability to access and apply for public funds [87], in addition to the utilisation of taxpayer money to achieve social value [88]. Nevertheless, the UK government has revealed its plans to invest in and support the sector towards MMC [17]. These arguments, hence, facilitate the questioning of whether the tendency of decision-makers in public clients' organisations to apply for public funds has a relationship with their level of innovation adoption, driving the following socio-economical hypothesis.

H2. *Credit attitude for funds and loans is positively related to MMC uptake.*

2.4.2. Personality Variables

The second cluster of variables that have been detailed in the DOI theory is one that links personality traits with innovation decisions [4]. In theory, personality traits may affect a decision and drive behaviour. However, applying this in the construction context, current knowledge is limited to what shapes public clients' personalities and how these influence their MMC uptake. This section, therefore, captures a spectrum of personality variables deemed critical for empirical validation. The detailed review of the literature enables

the authors to list captured variables as the tendency to seek less control and long-term relationships and abstraction capability.

A controlling personality trait is reasonably assumed to influence a less favourable decision toward innovations. In construction, clients tend to have such a characteristic embedded in their practices towards their supply chain [89]. Generally, construction clients prefer to have more involvement and effect on the process; this happens by engaging their teams to oversee the practices [42]. Such a trait is said to further intensify the existence of a construction innovation [51]. From a public sector perspective, designs are usually locked to better suit traditional methods, halting the potential to consider MMC as an option [90]. Eriksson et al. [64] explain this phenomenon, discussing that clients perceive a controlling trait as a necessary assurance that their needs will be effectively delivered. This motivates the authors to place a controlling personality trait under the personality variables and formulate a hypothesis to study whether such a trait exists in public clients and if it has an impact on their MMC uptake, leading to the following hypothesis.

H3. *The tendency to seek less control is positively related to MMC uptake.*

The adoption of innovations as early as their emergence from a conceptual concept rather than from peer adoption is described as the abstraction capability [4]. Such a personality trait is associated with early adopters compared to late or non-adopters of innovation. In construction, clients' dependency on others is perceived as imperative, particularly when making innovation decisions [61]. An interesting proposition is indicated by Xu et al. [91] who imply that clients' attain a stance in which a non-sensed and not clearly observed innovation is instantly excluded, describing it as an "out of sight, out of mind" approach. Observability, in this connotation, means that clients mimic their peers [59], a personality trait that has been discussed by Oti-Sarpong et al. [79] as a tendency embedded in clients and encouraged by perceived superior clients. In the MMC context, the abstraction capability personality trait has been linked to media exposure. Hairstans and Smith [92] touch on this and infer the role of media in communicating the robustness of MMC and addressing false perceptions. This aligns with Guribie et al. [93], who underline that the adoption rate of an innovation is directly linked to how clients are receiving credible data and information, implying the need for effective media strategies that may increase clients' abstraction capability. The second potential personality trait in public clients, hereby, would be the extent of their abstraction capability and its influence on their MMC uptake, motivating this research to assume the following hypothesis.

H4. *A higher abstraction capability is positively related to MMC uptake.*

2.4.3. Communication Behavior

The third cluster of variables in the DOI theory comprises the behavioural tendencies of decision-makers to connect with, and beyond, their social system. Communication behaviours have been shown to critically differ between early adopters and late or non-adopters [4]. This subsection, similar to the above, provides an in-depth review of the literature to capture variables that may be argued to exist in public clients and are deemed suitable for empirical validation, discussing the communication behavior-related characteristics of connectiveness and information gathering.

Connectiveness of decision-makers with other members of a social system is a communication behaviour that has been described to significantly differ from early and late adopters of innovations [4]. In the construction context, clients' connectiveness has been contended as vital in aiding their informed decisions [94]. Due to the fragmented nature of the construction industry, such connectiveness is necessary, where clients' sole decisions without communication with others have been discussed as not probable [84]. In the public sector, connectiveness among public clients is reasoned to yield an effective exchange of information and knowledge [95]. Such communication behaviour is not, however, a default characteristic in the public sector [41]. Connectiveness of public clients beyond the

boundaries of the public sector, with more engagement with private clients, has been well described as a positive behaviour shaping their connectiveness characteristic [60,96]. However, the connectiveness among construction clients, generally, remains a very understudied area requiring further research [97]. Hence, it is logical to state that the vast literature exists to reason the importance of connectiveness as a communication behaviour that encourages greater uptake of innovation, allowing this paper to derive the following hypothesis.

H5. *Connective and collaborative behaviour is positively related to MMC uptake.*

Seeking, or searching, for information regarding an innovation has been pinpointed as another communication behaviour that exists in adopters and is limited in late and non-adopters of innovations [4]. In the MMC context, locating and understanding relative information that would enhance a client's understanding of new methods is deemed critical [98]. Similarly, poor communication and lack of drive to search for information that can facilitate an informed decision have been identified as influencing factors undermining innovation adoption [93]. The literature focusing on this aspect is discreet, converging with other issues, such as MMC data accessibility [23] and the supply's potential to communicate reliable information [94]. Indeed, such aspects are of equal importance, however, the lack of studies on whether public clients are seeking information related to MMC, and if such a behavioural trait is influencing their level of uptake, motivates the paper to propose the following hypothesis.

H6. *A tendency to gather MMC information is positively related to MMC uptake.*

2.4.4. Public Clients' Norms

Authors have distinguished, in previous sections, the different nature and empirical settings of public clients compared to private construction clients. This difference is said to be nurtured by the radically different sets of interests and needs driving diverse purposes for each client type to pursue innovations [30]. The influence of these differences, however, is lagging in the literature and is limiting a broader understanding of what is important, or not, to the public sector. Similarly, in the DOI theory, the norms of a social system comprise influences on the innovation decision [4]. Hence, it is critical to study the characteristics attained by public clients due to their special nature beyond only those inferred by the above three clusters. This section includes, therefore, a spectrum of characteristics that are relevant only to public clients and that may aid a better understanding of the complex flow of decisions in this social system. The following subsections discuss the level of acceptability towards MMC, the set of priorities of public clients when procuring construction works, public clients' readiness for MMC policy mandates, and the level of confidence of public clients in the MMC market.

Change, indeed, is not a welcomed phenomenon among construction clients generally [42], particularly among public clients [54]. In the MMC context, change is inevitable, as the processes within these methods fundamentally differ from traditional construction [45]. MMC would mean moving away from uniqueness and flexibility to a more repetitive and standardised way of delivering construction projects [99]. This repetition approach is said to maximise the valuable benefits [100], but it also means that fewer client preferences are being met [48]. The traditionally preferred stance where clients can create a unique product is radically changed, influencing less flexibility and client engagement [101]. The current understanding of the level of acceptability of public clients towards this change represented by MMC's characteristics is limited, informing the need to test the following relative hypothesis.

H7. *MMC acceptability is positively related to MMC uptake.*

Another variable critically related to the norms of public clients is what they perceive as a priority. Public clients adhere to governmental policies and are ambitious to meet both special social goals [102] and public procurement regulations [41]. In their quest

to deliver social value, priorities emerge to include worker safety, quality, sustainability, skill development, carbon reduction, and digitalisation [17]. The range of requirements, therefore, better rank public benefit and welfare compared to the private sector that is driven by revenue [39]. For instance, one would argue that the staggering rates of housing shortages [26] emerge as a pressure that would significantly mean more to public clients than to private ones. In numerous case studies, MMC has proven to be a vital way to meet these priorities due to its largely controlled environment [15]. This paper, hereby, assumes that the more MMC benefits align with public clients' social needs, perceived as priorities, the greater the MMC uptake; thus, the authors formulate the following relevant hypothesis.

H8. *Prioritising public construction needs is positively related to MMC uptake.*

The growing governmental interest in MMC would mean a new set of policies mandating and promoting its use. The revised version of the Construction Playbook pinpoints this interest and interconnects the governmental direction in favour of MMC [17]. A new set of policy mandates is reasonably associated with additional tasks that may pressure public clients to plan a balance in receipt of their new public obligations [41]. Logically, public client organisations would differently react to these policies and some may be more ready than others. This is a public sector characteristic that demands an ability to acknowledge and embrace changing policies and instructions [69]. This encourages the authors to question, in essence, the readiness of public clients to welcome such MMC policy mandates, and whether their readiness would influence more MMC uptake, leading to the following assumption.

H9. *Readiness for policy mandates is positively related to MMC uptake.*

Public clients' perception of the market and the confidence that supply would meet their demand is another logical occurrence that is critical to the investigation. Reasonably, a market capability that can better communicate confidence to the public sector would yield more MMC uptake [103]. Due to their status and dependency on public funds, a favourable decision towards a construction innovation must be associated with a mature market that can deliver these needs and meet their priorities [104]. Areas of interest to detail the issue of confidence include the intention of public clients to adopt MMC in their future pipelines [17], the confidence in contractors to meet their needs [10], and the market's perceived maturity that would encourage uptake [83]. This empirical study, therefore, necessitates a further understanding of the level of confidence that these peculiar clients have towards the MMC market, motivating this paper to hypothesise the following.

H10. *Confidence in the MMC supply chain is positively related to MMC uptake.*

In summary, the DOI theory has been selected and utilised to help explain the low MMC uptake in the UK public sector in isolation from the popular direction adopted by vast research efforts. The theory, in addition to a thorough review of MMC-related literature, lists ten independent factors under four clusters that have been captured and deemed critical for empirical validation to test their influence on the one dependent variable — the organisations' MMC uptake. The ten hypotheses, shown in Figure 1, present an assortment of questions reflecting the interest to relate the adoption of construction innovations to the characteristics of decision-makers, for the first time, unravelling the relationships that are discarded by the literature in a very understudied sector. The following section discusses the choice of methodology to approach the aim of this paper.

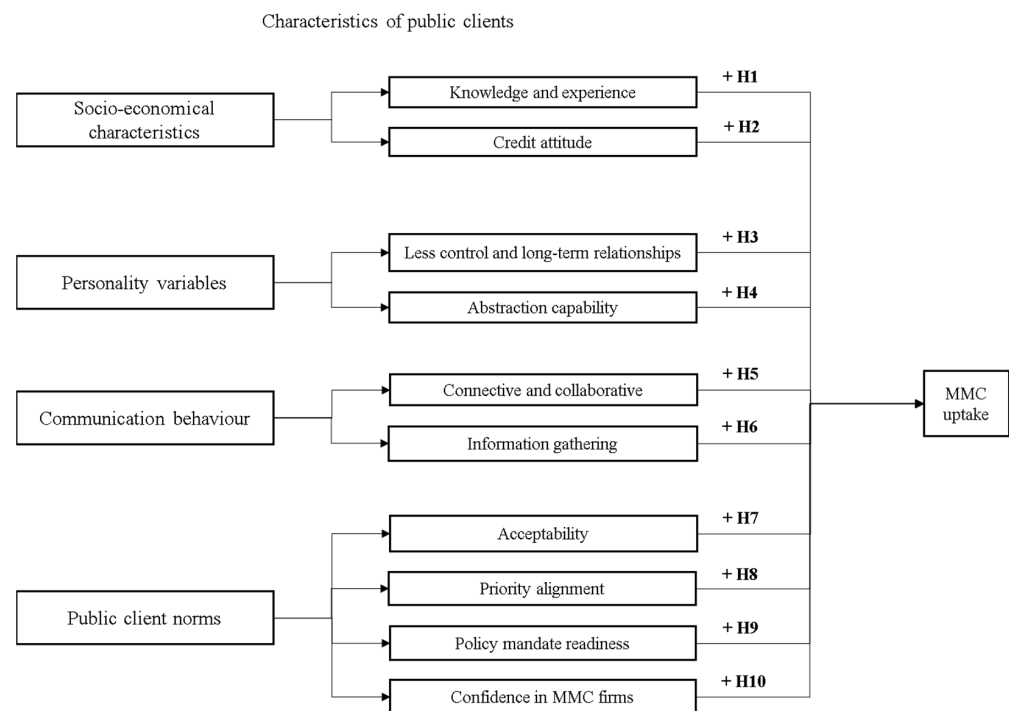


Figure 1. The hypotheses on the influence of the captured variables on MMC uptake.

3. Materials and Methods

According to Kothari [105], a methodology is a key consideration of any research, and this section will detail for readers the means of sampling, the instrumentation of data collection, and the measures taken to ensure the validity and reliability of the approaches. The authors' choices are influenced by the philosophical stances adopted herewith [106]. The formulation of the hypothesised relationships demands an empirical quantitative validation that would reveal the extent to which the captured variables are significant. This choice of methodology is the default and popular method when assessing the factors of influence and establishing an evidence-based relationship among independent and dependent variables [83]. The authors' aim is to reveal reality, which is seen as independent, marking this approach as objective and neutral [107]. Therefore, the ontological stance that best describes this study is a positivist one, where authors tend to measure, and discover, the logic behind reality rather than influence it [108]. Epistemologically, this paper aligns with the deductive principle explained by Lumer [109], who established that "a proposition is true if it has been correctly verified". The adoption of the constructs from Rogers' [4] theory and the subsequent development and testing of multiple hypotheses fall within this reasoning. This section presents the sampling and collection of data, which is then followed by the results section that details and validates the statistical analysis method of linear regression to meet this study's aims and objectives.

Sampling and Collection

This paper adopts a purposive sampling approach to collect data from the relevant population that represents the UK public sector. Such a sampling approach allows the authors to invite inputs from participants based on their ability to contribute to the research [110], and in turn, significantly enhances the quality of the study [111]. This choice of sampling means that respondents are chosen in relation to the attainment of in-depth knowledge to reflect on, or answer on behalf of, their organisation's decision-makers. To pinpoint this approach, a prequalification criterion was applied to ensure the desirable purposiveness (see Table 1). The choice of purposive sampling meant that a non-probability, or non-random, and subjective tactic is followed to identify participants that are representative of their population [112]. The sampling approach extended from January 2021 until

August 2022, a period when potentially qualified participants were added to a network of connections.

Table 1. Conditions and survey measures utilised to sustain credible results.

Condition	Adopted Measure
Geography: Located in the UK Represent a UK public client	<ul style="list-style-type: none"> • Only UK institutional emails are accepted. • First question declaration required to proceed.
Knowledge: Individuals knowledgeable of their organisation's decision-making	<ul style="list-style-type: none"> • Higher management roles are contacted. • All survey questions are mandatory to answer for completion.
Type: Organisation that has the frequency and capacity to procure construction works	<ul style="list-style-type: none"> • Type of organisations accepted are local government, central government, NHS, Central purchasing bodies, housing associations, and educational establishments. Other agencies or private sector firms are excluded.
Terminological clarity: Coherence of terms used in the survey	<ul style="list-style-type: none"> • UK government's adopted definition provided for clarity.

Sampling included attaining potential respondents' institutional email addresses and being followed on social networks. Such an approach meant that potential respondents may be familiar with the researcher's name, and vice versa, where the researcher avoided a random sampling, reflecting a more credible standing when requesting data by approaching positions that respondents would agree to represent and were qualified to respond to on behalf of their organisations. Overall, 490 institutional emails were individually sent through the researcher's university email, achieving 91 valid responses between July and October 2022, with a response rate of 18.6%. Compared to other studies that included a sample from the public sector, this paper's rate is deemed acceptable. For instance, Walker and Brammer [37] achieved a response rate of 10% with 106 total responses, Li et al. [113] achieved 12% with 61 responses, and Lohmann and Rötzel [114] achieved 22% with 77 responses.

The arguably low response rate is linked to, as often reported by non-responders, the extremely busy nature of the public sector in addition to the inability of the vast majority to fully complete the questionnaire, which demands a position of extensive knowledge and senior involvement, when answering questions about their organisation. Despite the researcher's reiteration of the ensured confidentiality and voluntary nature of the survey, several respondents shared relevant concerns and avoided providing a response. This could be linked, speculatively, to the political stance that steers public client positions, nurtured by accountability [115], where logical precautionary measures are taken to avoid unnecessary jeopardisation by answering in-depth questions on behalf of their public organisation. As shown in Table 2, the sample fairly represents public client organisations, commonly related through adherence to public law, that are capable of frequently procuring construction projects, a sample that is deemed credible in reflecting public clients' characteristics.

Table 2. Represented public client organisations in relation to their MMC uptake.

	MMC Uptake (Number of Projects)					Total
	Zero	Up to 10	Up to 25	Up to 50	Over 50	
More than 1000 employees	6	30	2	4	5	47
Central Government		1				1
Council	2	13	1	3	4	23
Educational Establishment	1	2	1			4
Housing Association		4				4
Local Authority	2	4				6
NHS	1	6		1		8
Non-Departmental Public Body					1	1
Between 501–1000 employees	6	9	1			16
Council	2	5				7
Educational Establishment	3					3
Housing Association		3				3
Local Authority	1	1	1			3
Between 251–500 employees	6	7		1		14
Council	2	5				7
Housing Association	1			1		2
Innovation Agency	1					1
Local Authority	2	2				4
Between 50–250 employees	2	4		1	1	8
Central Purchasing Body				1	1	2
Council	1	2				3
Housing Association	1	1				2
Local Authority		1				1
Up to 49 employees	4	1		1		6
Central Purchasing Body				1		1
Housing Association	3					3
Local Authority	1	1				2
Total	24	51	3	7	6	91

4. Results

4.1. Reliability and Validity: Internal Consistency

To ensure the reliability and validity of the survey tool that is meant to capture and assess quantitative data, key considerations were applied. Initially, questions were drafted to align with the previously conducted review of the literature, comprising scholarly and peer-reviewed published work, enabling the author to extract the variables that relate to the theory and direction of this paper (see Table A1). Moreover, conducting a pilot study warrants this method choice and pinpoints the validity of the approach, while making it coherent, sensible, and prompt to complete [116]. To approach an effective pilot study, three senior positions from a public purchasing body were consulted to provide their thoughts on the questionnaire. Recommendations received included critical amendments such as the terms used, questions' sequence, and rewording to better suit the UK English style and context. Moreover, upon adhering to changes from the public sector, three academic professors were consulted to similarly provide feedback; changes included more coherence to the questions without a change in meaning. Overall, the changes applied led to a clear, short, and reliable tool deemed ready for circulation. This was, in addition, confirmed by the first five responders, who successfully completed the questionnaire knowing that all questions are mandatory.

Statistically, the internal consistency of the included variables in this paper has been measured by Cronbach's alpha coefficient [117], a popular test for correlation in the global

academic body. A followed rule, herewith, is that the range of the alpha coefficient should not plummet below 0.6 for good reliability, which is considered highly accepted in samples up to 100 [118]. As shown in Table 3, all values ranged between lower 0.6 and higher 0.8, proving that consistency exists among all the variables. Since none of the alpha values is below 0.6, the acceptable rule of thumb is deemed sufficient to proceed with the clustering choice.

Table 3. Testing internal consistency with Cronbach’s alpha coefficient.

Constructs	Factors	Items	Cronbach’s Alpha
Socio-economical characteristics	• Knowledge and experience	3	0.668
	• Credit attitude	2	0.765
Personality variables	• Seek less control and long-term relationships	2	0.640
	• Abstraction capability	2	0.804
Communication behaviour	• Connective and collaborative behaviour	6	0.832
	• Information gathering	2	0.892
Public clients’ norms	• MMC acceptability	3	0.723
	• Priority alignment	4	0.815
	• Readiness for policy mandate	2	0.929
	• Confidence in MMC firms	5	0.874

Furthermore, other tests were applied to reflect the robust reliability of the captured variables. The Kaiser-Meyer-Olkin (KMO) test has been used to assess whether the sampling approach is adequate. In addition, the Bartlett Test of Sphericity (BTS) has been utilised to assess the adequacy of collinearity. Both tests yielded reassuring and acceptable results of KMO being 0.698, and $BTS < 0.001$ [119]. Finally, the extraction sum of squared loadings, namely the Harman single-factor test, yielded a percentage of 22.629%, which is less than the 50% recommended by Eichhorn [120], indicating the absence of a common data bias. Hence, the preliminary procedures and tests used underline the reliability and validity of the collected results, allowing this research to proceed to the analysis phase, discussed in the following subsection.

4.2. Linear Regression Analysis

A linear regression analysis is selected in this study to articulate and make sense of the relationships learned from the collected data. This choice aligns with the aim of this paper, where the influence of the characteristics on the innovation decision, represented and measured by the actual MMC uptake, is studied in relevance to their significance. The selection of the regression analysis, in addition to its extensive usage as one of the widely preferred analysis approaches in applied statistics [121], tends to explain the influence of significance between independent and dependent variables [122], which aligns with what this paper aims to pursue. Moreover, the software that supported the analysis of data is SPSS Version 28.0.1.1 by IBM, a popular statistical package amongst the global academic body [123]. This section, therefore, interchangeably tests, validates, and invalidates the ten hypotheses.

To ensure that the choice of linear regression analysis is acceptable and suitable based on the collected data, a regression standardised residual test has been made (see Figures 2 and 3), indicating the normality of residuals where the dots generally line up along the diagonal line. Moreover, the results for the standard residual, -2.115 and 2.324 , fall within the recommended -3.29 and 3.29 scale, and the Durbin-Watson test yielded a 1.726 score, which is neither less than 1 nor greater than 3, meaning that the assumption of the independence of observations has been met [105]. The outcomes of these tests underline that no outliers exist and reflect the

suitability of the linear regression method of analysis. The results of the analysis are presented in Table 4.

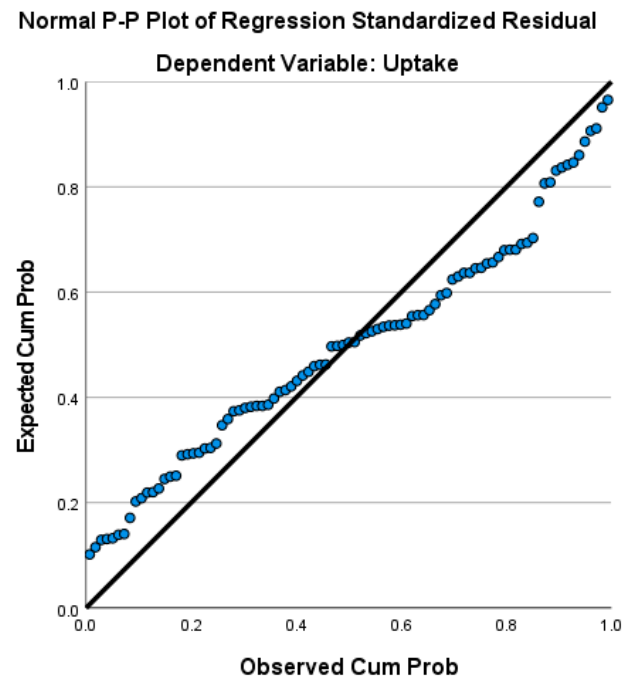


Figure 2. Formality of residuals of 91 responses.

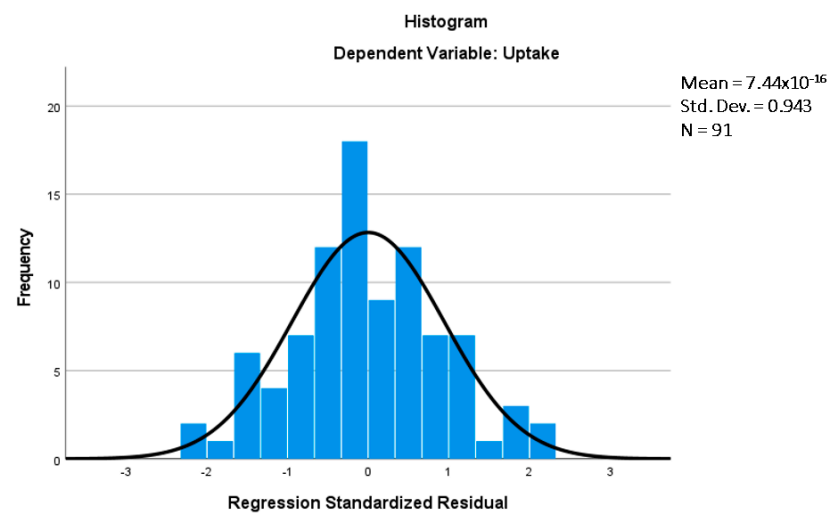


Figure 3. Standardized residual against frequency in relation to MMC uptake.

The results indicate that none of the socio-economical characteristics and communication behaviour factors tested have an influence on the MMC uptake in public client organisations. The most significant factor is in the public client norms cluster, indicating that public clients' confidence in the MMC firms to meet their needs and wants is the most significant factor of $p > 0.001$. Moreover, at a 90% confidence level, public clients who have a tendency to control less and that seek long-term relationships have a higher likelihood to have a higher MMC uptake. Therefore, this study only has one mostly significant and supported hypothesis from the DOI theory at a 95% confidence level which is H10.

In contrast, results show that knowledge and experience (H1), credit attitude (H2), abstraction capability (H4), connectiveness and collaborative behaviour (H5), information gathering (H6), acceptability of change (H7), priority alignment (H8), and readiness for policy mandates (H9) all have a greater than 0.1 sig. value. These results reflect, therefore,

that these assumptions are not supported and are deemed as characteristics with no recorded influence on the MMC uptake of public client organisations. The following section will include discussions and arguments to explain these results (see Figure 4).

Table 4. Regression analysis coefficients.

Coefficients ^a						
Model	Unstandardized Coefficients		Standardized Coefficients		t	Sig.
	B	Std. Error	Beta			
(Constant)	6.160	3.432			1.795	0.076
SEC01	−0.022	0.146	−0.015		−0.149	0.882
SEC02	0.236	0.190	0.140		1.241	0.218
PV01	−0.380	0.216	−0.174		−1.760	0.082
PV02	−0.138	0.210	−0.069		−0.657	0.513
CB01	−0.023	0.112	−0.029		−0.209	0.835
CB02	0.288	0.285	0.165		1.011	0.315
PC01	−0.004	0.183	−0.003		−0.023	0.981
PC02	0.133	0.147	0.081		0.907	0.367
PC03	−0.085	0.181	−0.044		−0.468	0.641
PC04	0.433	0.090	0.485		4.792	<0.001

^a. Dependent variable: MMC uptake; ^b. predictors (constant): socio-economical characteristics, personality variables, communication behaviour, and public client norms.

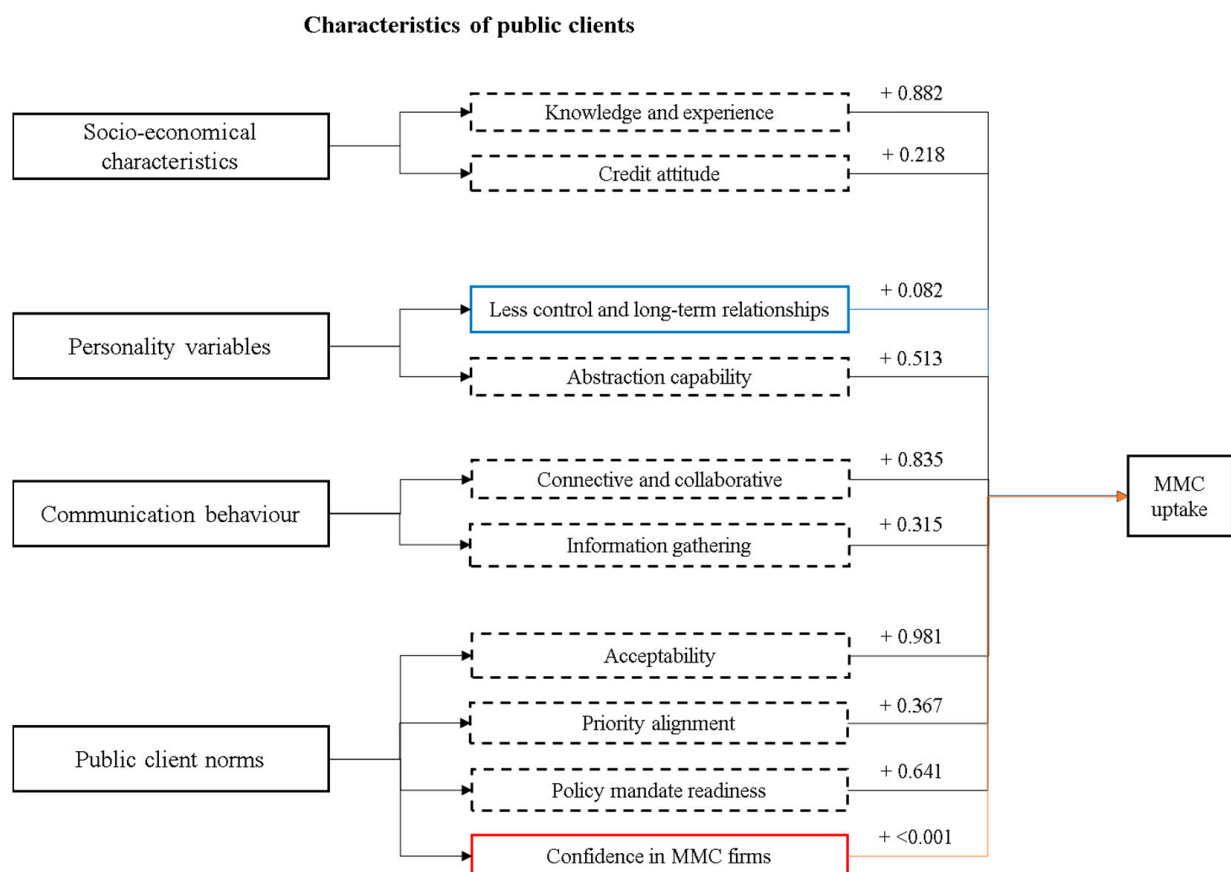


Figure 4. Characteristic influence on public clients’ MMC uptake. The red characteristics for significant influence ($p < 0.05$), the blue characteristics for moderate influence ($p < 0.1$), and the dotted characteristics for no influence ($p > 0.1$).

5. Discussion

This paper followed an unusual route of studying demand in isolation compared to the more popular academic route of studying innovation. A linear regression analysis enabled the authors to test whether the attainment of a spectrum of characteristics in a public client organisation influences their MMC uptake. Overall, the adoption rate of MMC projects among public clients is perceived as very low (see Figure 5). The choice of analysis yielded results that unravelled the highest influencing characteristics, promoting a range of arguments and in-depth discussions as shown in the following subsections.

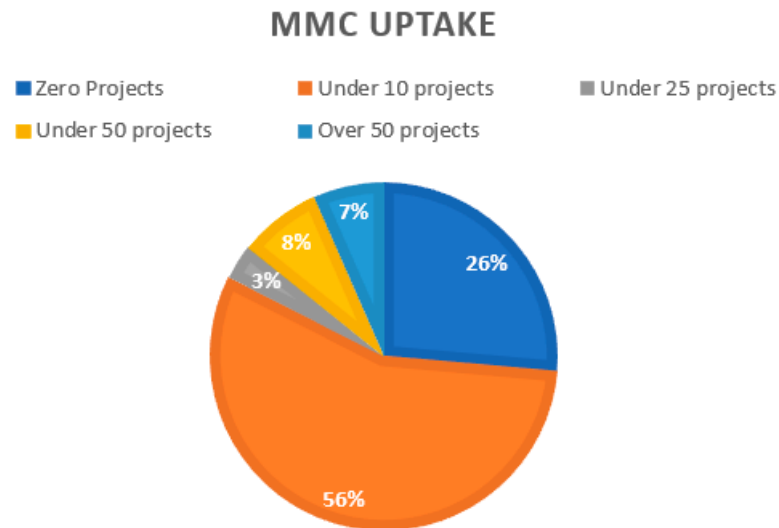


Figure 5. The percentages of respondents' answers against their MMC uptake.

5.1. Public Clients' Confidence: A Change-Driving Characteristic

Confidence is built by the trust of public clients in contractors' ability to deliver value and share a common meaning for public welfare. Confidence, transpiring as the most significant factor in the adoption of MMC, comes as non-surprising. Indeed, the results of this paper are consistent with previous academic efforts that made confidence and trust the forefront interests [103,124–126]. However, the results align with what has been argued by Eichhorn [59], that the matter of confidence, and how the same is communicated, act as a double-edge stance, facilitating MMC at times, but also significantly halting wider uptake at other times, without any coherent frame of reference. Hereby, a mature organisation that succeeds in attaining clients' confidence is a key contractor attribute [104]. The matter of price in the public sector, therefore, is not alone what determines public clients' choice of methods, but it is the sureness that the market critically understands their needs [127]. Moreover, Järvenpää et al. [89] discuss the relationship between confidence and relationship history between public clients and their supply chain; based on the results, it is logical to state that the MMC uptake in the public sector is low, inhibiting the development of a robust relationship history that can better boost public clients' confidence as a reference. Such history, and familiarity, means that clients are aware that MMC firms have no foundations or past actions that can aid their competence to penetrate the public sector [89]. Therefore, it is reasonable to state that this study's findings extend a better understanding of the most influential variable driving the public sector's adoption of MMC and reveal the interplay between the level of market confidence perceived by public clients and their uptake of MMC projects as a critical gateway for both research and practice.

5.2. Less Control and Long-Term Relationships

A non-controlling characteristic that seeks long-term relationships is seen to have facilitated the level of uptake of public client organisations. Despite only achieving significance at a 90% confidence rate, this can be explained by the nature of construction

procurement where control could be better sensed at the post-innovation decision and not before, meaning that controlling personality traits of decision-makers would have more influence on the innovation's processes and project delivery rather than on the actual adoption and uptake. Such discussions align with Granheimer et al. [128], who infer that public clients tend to focus on results and output measurability of innovative solutions and are sure in their public sector's contractual firmness and ability to address their initial concerns [89]. Hence, a less controlling trait that welcomes long-term relationships is seen as an important factor that can predict the higher likelihood of an MMC uptake.

5.3. Important as Characteristics, Insignificant as Influences

Surprisingly, and in contrast to the above-captured characteristics on the MMC uptake, other characteristics have no significant influence. For instance, a characteristic that distinguishes adopters from low or none-adopters is public clients' behaviour to seek new and relevant MMC information. The findings suggest that the construction setting, with regards to innovations, is consistent with other industries, aligning with Rogers [4] on the level of significance associated with decision-makers who take the initiative to gather relative information on innovation adoption. Surprisingly, the results inform the authors that organisations that have invested in the approach of seeking more information on MMC had no influence for a significantly more favourable decision to adopt the innovation compared to organisations that didn't share the same drive and characteristics. The discussion, therefore, aligns with what has been stated in Chia and Holt [129] and Chia [130] on viewing the relevant practice as driven by a 'becoming' mindset and not as a 'being' one, a stance that encourages seeking a flow of new information rather than accepting a static status of readily available ones. Tentatively, Kuitert et al. [41] argue that the public construction sector is aware of such characteristics, yet it remains limited and not driven within the social system despite its influence. Hence, seeking and gathering information is an important factor that surprisingly has not been realized as a significant predictor of MMC uptake in public client organisations.

Another surprisingly non-influencing characteristic is risk-taking. It is logical to state that in the construction setting, this contradicts other studies on the ability of such a personality trait to promote the adoption of innovations among decision-makers [4]. The lack of influence of a risk-taking personality trait on the organisation's MMC uptake can be explained by the existence of contractual arrangements that govern risks in the public sector. For instance, these findings align with previous public sector research that included a construction innovation where the coherence created by the social norms and contractual underpinnings meant that the client was driven by confidence in the formal mechanisms rather than the innovation itself, which may have limited the role of a risk-taking personality trait on the innovation-adoption [131].

The abstraction capabilities of public client organisations have a similar lack of influence on MMC uptake. These findings come surprisingly in the lack of a relationship between such capabilities with public clients' MMC adoption rates, contradicting previous studies such as Zahra and George [132] and suggesting that MMC could differ as an empirical setting from that of other construction innovations. This could be explained by the complex process of public clients' decision-making that flows regardless of their exposure and drives the adoption of new ideas [127]. Such complexity is argued to be nurtured by the extensive procedures associated with public procurement [133], requiring adherence to a set of measures regardless of the abstraction capabilities. Hence, even if superior peers adopt MMC [79] or the decision makers' exposure to media [92], the abstraction capability proves insufficient influence to steer a change in public clients' MMC uptake rates.

Connectiveness of public clients is another communication behaviour that is thought to be insignificant to driving an organisation's MMC uptake. The connectiveness of decision-makers, whether with their peers or beyond their social system, has been underlined as a critical characteristic influencing innovation adoption [4]. Such a characteristic, however, seems trivial in the public construction sector with respect to the MMC uptake. This may be

explained by the dynamics within public procurement, including a special route for tendering, that limits the continuity of relationships [134]. Moreover, Järvenpää et al. [89] argue that the construction industry is project-based, where relationships tend to be temporary, undermining the effective formation of a relationship history as a frame of reference. Such a peculiar public sector nature, therefore, limits the ability for relationships to build through time and effort exclusively as described by Dekker et al. [135]. Albeit a key attribute that can be associated with a myriad of communication values, the level of connectiveness of public clients proves to have no influence on the level of MMC adoption in the public sector.

Finally, this paper has studied the potential relationship between public clients' readiness to embrace governmental regulations and policy mandates with their MMC uptake. Findings reflect that no influence exists between organisations that are ready to embrace a mandate and others that are not. This could be explained by the very similar nature of these organisations [136], adhering to one public law as their tendency to welcome or reject policy mandates has no influence on the overall rate of innovation adoption. Such results, however, inform us that although the readiness to embrace these policies may be irrelevant to the uptake of MMC, the public sector is encouraged to ensure that unnecessary restrictions associated with these policies and procedures are not influencing the supply's potential to maximise their revenue [127]. Moreover, these results do not suggest that new tasks associated with a policy mandate would not influence the delivery of the innovation, as the readiness of clients to embrace a degree of responsibility may remain a valid post-adoption argument [137].

6. Conclusions

This paper has aimed to reveal whether a set of literature-extracted variables exist in public client organisations and whether these have any influence on their MMC adoption rates. Four key variable clusters have been adapted from the DOI theory. The three clusters are Socio-economical Characteristics, Personality Variables, Communication Behaviour, and Public Client Norms. Subsequent to the relevant tests confirming the suitability of the analysis choice, the linear regression analysis of the dataset enabled the authors to examine the influence of each variable under each of the clusters on the MMC uptake rates as recorded from public client organisations.

By studying an academically understudied sector like the public construction sector, it has been evident to the authors that the issue of communicating confidence emerges at the top of this paper's contributions. The findings suggest that the communication line between MMC supply and the public sector's demand is weak. The organisational confidence in the capabilities of the market to deliver their needs had the highest level of MMC uptake, whereas those who perceived that the market lagged in their innovation adoption had lower levels of MMC uptake. However, overall, the uptake of MMC among the sample reflected very low adoption rates. This indicates that the line of communication between parties needs strengthening beyond the currently adopted media strategies and campaigns to ensure a relatively reliable and credible, flow and transfer of information and knowledge which can increase clients' confidence.

The findings show that decisions are not solely steered by issues associated with the innovation itself, like the direction of the vast literature, but are also linked to the ability of the supply chain to influence demand. This study echoes previous research efforts on the importance of the public sector in sharing a common meaning with public clients on the requirements that ensure public welfare and sustain a sufficient flow of relative information among personnel and decision-makers. These characteristics would enable wider MMC uptake due to the reinforced confidence, and organisations attaining these characteristics would statistically achieve a more favourable decision towards MMC.

Compared to the popular direction of construction management research, in focusing on innovation rather than on the adopters, this study reflects the importance of studying public clients as highly discarded social systems within existing research efforts. Future research, therefore, is encouraged to investigate the features that are attained by MMC

firms achieving a considerably higher business with the public sector and relating these features to the communication of confidence. It is tempting to speculate and examine the differences in supply's business models, and what could be revealed by the in-depth analysis of these differences, which may aid research and practice to better understand the business elements that prove to be effective in achieving a higher influence, through reinforcing confidence, when penetrating a highly complex social system like the public sector. In other words, the betterment of the current MMC uptake in the construction industry is strongly linked to the supply side, and capturing the weaknesses of MMC firms to communicate confidence may have strong implications on the course of uptake that may reveal critical functions undermining MMC adoption. Therefore, the results of this paper are critical for both practice and research, which motivate future efforts to better understand how supply can influence demand's confidence by achieving a higher business competency in the UK public sector.

In terms of limitations, a key limitation of this study is arguably the small sample size of responses (ninety-one responses). A justification for this is the extreme challenge of finding and encouraging personnel from the public sector to acquire the time, knowledge, and suitable position to provide inputs that represent their organisation's past, present, and future processes. As stated in the relative subsection of the collection process, the researcher spent nearly two years connecting with potential respondents to achieve the highest possible response rate. Despite this study meeting its objectives, a higher response rate would be more favourable in similar studies. With a higher response rate, results may have favoured more characteristics to fall below the 0.05 margin of significance at a 95% level of confidence. As an attempt to arguably mitigate this, the authors have followed the footsteps of vast research and accepted the hypotheses that fell within the 90% level of confidence but not greater than the 0.1 margin of significance. Moreover, another limitation of this study may be the use of wordings and keywords. The authors acknowledge that a choice of a different set of wording may result in more studies that have a different MMC description, wording, or definition and that the choice is highly relevant to the United Kingdom's accepted terminologies. Such choice of wordings in this study can be argued to have facilitated imbalance between the regionally agreed terms to describe MMC. The use of broader search codes and terminologies to describe the same philosophy may have resulted in more characteristics relative to the context of this research. However, the results of this study can still be applicable to a variety of public construction clients from other regions, due to the globally similar nature of the public sector compared to the private one, and it is not possible to include the vast MMC literature in one academic paper.

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Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, and approved by the Institutional Review Board (or Ethics Committee) of Leeds Beckett University, United Kingdom (reference 101042, 25 July 2022).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Not applicable.

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Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Table A1. Likert scale statements used in this research.

	Measuring Statement
1.	Colleagues who make decisions regarding MMC uptake in our projects have higher education degrees
2.	Colleagues who make decisions regarding MMC uptake in our projects have experience using MMC
3.	We employ staff with knowledge and experience in MMC
4.	Has requested or has the intention to request government funding to add MMC to our pipeline of works
5.	Is aware of existing funding initiatives to encourage MMC uptake
6.	Tends to have very few amendments to the standard forms of contracts when procuring
7.	Prefers long-term relationships with the market
8.	Welcomes new ideas and concepts even if not well-experimented
9.	Would adopt an innovation before other peers
10.	Is highly engaged with media and construction innovation events
11.	Created a network of connections to stay informed about MMC
12.	Is open to collaborating with other public clients to achieve an economy of scale
13.	Is well connected with other public clients
14.	Supports exchanging knowledge with other public clients
15.	Supports exchanging knowledge with private clients
16.	Regularly seek knowledge and information about MMC
17.	Has great exposure and is following MMC media platforms and channels
18.	Prefers new and emerging methods as an alternative to traditionally procured construction
19.	Prefer new and MMC-specific public procurement agreements
20.	Prefer MMC-only contractors compared to contractors with traditional experience
21.	Reducing construction carbon is our priority
22.	Reducing construction waste is our priority
23.	Ensuring worker safety and well-being is our priority
24.	Need for more digitalisation is our priority
25.	Clarity and Guidance of government policies and directives to adopt MMC are not in our felt problems
26.	Mandating governmental policies and directives to adopt MMC are not in our felt problems
27.	Trust the MMC market to meet our preferences
28.	Recognise the ability of the MMC market to meet our current or future needs
29.	Trust MMC firms to mitigate risks associated with MMC
30.	Confidence in MMC firms
31.	Perceive MMC firms as mature
32.	Uptake: Number of MMC projects procured
33.	We have the intention to use MMC

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